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# PROJECT BACKGROUND

* The project name in Vietnamese: “Nâng cao hiệu quả sử dụng nước cho các tỉnh bị ảnh hưởng bởi hạn hán” (WEIDAP/ADB8).
* The project name in English: Water Efficiency Improvement in Drought-Affected Provinces.
* Sponsor: The Asian Development Bank (ADB).
* Executive Agency: Ministry of Agriculture and Rural Development
* Implementation duration: From 26 June 2019 to 31 December 2025*.*
* The Water Efficiency Improvement in Drought-Affected Provinces Project integrates climate-resilient agricultural practices through a transformational shift in irrigation modernization, including (i) strengthening irrigation management to improve climate resilience, (ii) modernizing irrigation infrastructure, and (iii) supporting efficient on-farm water management practices. Specifically, the project will modernize eight irrigation systems respectively eight Subprojects: Du Du-Tan Thanh, Tra Tan, Dak Lak, Cu Jut, Dak Mil, Cam Ranh–Suoi Dau, Nhon Hai–Thanh Hai, Thanh Son–Phuoc Nhon in five drought-affected provinces: Binh Thuan, Dak Lak, Dak Nong, Khanh Hoa, and Ninh Thuan. The modernized systems will enhance the provinces' ability to manage climate variability, improve the water productivity of agriculture, and increase incomes by supporting farmers in growing high-value crops (HVCs) such as coffee, peppers, grapes, apples, dragon fruits, and mangoes. The project was predicated by the El Niño Southern Oscillation (ENSO)-induced drought in 2014 2016, which affected Viet Nam's south-central coastal and central highlands regions.

## Rationale

* Viet Nam’s agriculture sector experienced a rapid transformation with the introduction of Doi Moi economic reforms in the mid-1980s. Production tripled between 1990 and 2013, propelling the country to the rank of leading exporter of agriculture commodities including cashew, pepper, coffee and rice. This in turn has contributed substantially towards reducing poverty and addressing food security especially among rural communities, where 90% of the poor reside. The sector contributed about 18.3% of gross domestic product and 44% of its labor force from 2008−2016. A key factor contributing to this remarkable transformation was a substantial investment in developing the country’s irrigation and drainage infrastructure. As a result, Viet Nam has one of the highest levels of irrigation coverage in Southeast Asia, accounting for about 50% of its arable land area. However, more than half of the irrigation systems operate below their potential capacity mainly because of the poor condition of the asset base. Inadequate and deferred maintenance is a leading cause of premature deterioration of irrigation infrastructure.
* The southern central coastal and central highlands regions of Viet Nam are particularly vulnerable to climate change. A climate vulnerability assessment carried out for the project indicated that changes in precipitation will result in hotter and wetter wet seasons and hotter and drier dry seasons. A reduction in flows can be expected in hotter years because of higher evapotranspiration and the delayed onset of the southwest monsoon. The ENSO-induced drought in 2014−2016 was the most severe in 40 years, and rainfall during the 2015 monsoon period was 40%−70% below the long-term average. About 60,000 hectares of agricultural land in the central highlands was affected to varying degrees, including permanent loss of perennial crops such as coffee and pepper. The impact is most severe on smallholder farmers who rely on rainfed surface water sources for irrigation.
* Water scarcity and economic factors have prompted farmers in the south central coastal and central highlands regions to grow HVCs that can withstand longer dry spells and are more suited to the changing agroecological environment. Notably, an increasing number of farmers are also adopting on-farm micro-irrigation practices such as drip or sprinkler systems. They do so primarily to reduce input costs, including labor, electricity (mainly for pumping of water), and fertilizer. Irrigation systems supporting HVCs and micro irrigation must be sufficiently robust to support the desired level of service, and flexible (able to irrigate only when required), reliable (able to deliver water at a specified flow rate and duration), and accessible (with a point of delivery within 1 kilometer of the farm gate). However, many irrigation existing systems were originally designed for rice and are inappropriate for HVCs because they: (i) lack flexibility to provide water on demand, since the conveyance and control structures are designed for flood irrigation; (ii) are less reliable and efficient, in part because of poor maintenance; and (iii) present challenges for water management, due to difficulties related to access control and enforcement of water allocation rules.
* To address the issue, the project will combine an innovative solution of pressurized piped irrigation systems with high level technology that meets the level of service required by farmers growing HVCs. These will function like domestic water supply systems and provide water on demand through a system of hydrants and control valves, thereby giving farmers greater flexibility to control the amount and duration of irrigation. Piped distribution systems also allow operators to control and measure water more effectively and apply volumetric water charges. These are necessary conditions to improve efficiency and sustainability, particularly in the operation and maintenance (O&M) of systems, including through third-party service contracts. Finally, piped systems are more resilient to extreme weather conditions and require less maintenance, making them more efficient and cost-effective in the long-term.
* The uptake of on-farm micro-irrigation practices by farmers in the project areas is supporting a local micro-irrigation solutions industry. However, farmers lack awareness of and extension services to help them optimize micro-irrigation options and adopt good practices, including fertigation methods. The project will also strengthen the capacity of farmers to use and operate micro-irrigation techniques aimed at improving on-farm water productivity. Once the irrigation systems are fully operational, incremental production of HVCs such as dragon fruit, coffee, black pepper and mangoes are expected to boost incomes in the targeted provinces.
* The project aligns with key government policies, strategies, and laws, including (i) the government’s agriculture restructuring plan, which focuses on sustained growth, improved efficiency, and competitiveness of the sector through increased productivity, quality, and value addition; (ii) the Ministry of Agriculture and Rural Development (MARD) strategy that calls for adopting advanced and water-saving irrigation techniques and technologies on 500,000 ha of upland crops by 2020 to improve productivity, decrease irrigation water use, and increase household incomes; (iii) the national climate change strategy, which aims to guarantee food security and water resource security; and (iv) the Law on Hydraulic Works (2017), which allows for water pricing for irrigation services.

## Impact and Outcome

* The project is aligned with the following impact: climate resilience and water productivity in agriculture improved. The project will have the following outcome: climate-resilient and modernized irrigation systems in five provinces established.

## Outputs

* **Output 1**: **Irrigation management services strengthened**. This output will support policy and institutional development measures to improve climate resilience of agriculture by strengthening irrigation management while taking social and gender dimensions in all relevant activities into consideration. Specifically, the project will (i) install irrigation water allocation and delivery services, including (a) surface and groundwater assessments, (b) an irrigation water-sharing and allocation framework, and (c) a real-time decision support system for farmers to optimize crop water application; and (ii) improve maintenance of irrigation systems, including (a) developing an asset inventory and management database for each irrigation system supported by the project, (b) developing a systematic asset maintenance schedule with a rigorous approach to funding based on asset condition assessments, (c) developing a water charge pricing framework, and (d) assessing options for engaging third parties in O&M of irrigation systems.
* **Output 2: Modern irrigation infrastructure developed**. This output will modernize eight irrigation subprojects in the five provinces to provide water on-demand to farmers cultivating HVCs, reducing their vulnerability to climate change. The underlying principle of all systems is to provide a higher level of service—more flexible, reliable, and accessible supply of water—to farmers than they currently receive. The infrastructure works include three broad categories:(i) pressurized pipe systems that connect canals or reservoirs with supply hydrants located in reasonable proximity to farmers’ fields (enabling direct connection with a hose), with basic supervisory control and data acquisition systems to facilitate operations and monitoring of system flows (consultations with male and female farmers will inform the design and implementation of activities); (ii) main system modernization, including canal lining, control structures, storage, and installation of flow control and measurement devices with remote monitoring; and (iii) new and improved weirs to replace temporary weirs constructed by farmers to provide storage from which farmers can pump to irrigate HVCs. Other works include upgrading culverts and farm roads to improve management of irrigation systems.
* **Output 3: Efficient on-farm water management practices adopted**. This output will focus on improving on-farm water productivity in the subproject command areas to improve climate change resilience. Water productivity assessments conducted under output 1 will help determine suitable norms for different crops under different agroecological conditions. Based on this information, farmers will receive training and advisory services to improve on-farm water management to cope with climate variability. The service providers will consult with and provide technical advice to male and female farmers to identify and develop appropriate micro-irrigation systems that meet their individual requirements. Farmers will also be linked with private sector suppliers and provided O&M training on micro-irrigation systems.

# OVERVIEW OF CAM RANH – SUOI DAU SUBPROJECT

## General information

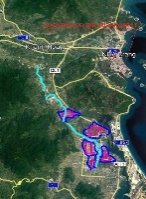
* Subproject name: Improving and upgrading south main canal of Cam Ranh reservoir and main canal of Suoi Dau reservoir in Khanh Hoa province
* Sponsor: The Asian Development Bank (ADB)
* Executive agency: Khanh Hoa Provincial People’s Commitee
* Implementing agency (Investor): Khanh Hoa Department of Agriculture and Rural Development
* Implementing agency representative: Khanh Hoa Provincial Project Management Unit
* Subproject areas: 9 communes including Suoi Cat, Suoi Tan, Cam Tan, Cam Hoa, Cam Hai Tay, Cam Hiep Bac, Cam Duc, Cam Hiep Nam, Cam Thanh Bac; Cam Lam District, Khanh Hoa Province.
* Implementation duration: From 26 June 2019 to 31 December 2025.

## Technical works proposed \*Các mục nhỏ lại không hoàn toàn là technical works ???) at the approved feasiblity study level designs

* The Feasibility Study for Cam Ranh – Suoi Dau Subproject was approved by Khanh Hoa Provincial People’s Committee at the Decision No. 1807/QĐ-UBND on June 22, 2018
* The subproject consists of two separate storage irrigation systems supplied from existing Suoi Dau and Cam Ranh reservoirs. Both combine rehabilitation of existing gravity canal systems and new pumped pipe systems. The existing gravity canal systems will supply rice and mango areas and the new pumped pipe systems will supply established and expanded mango areas.
* The Suoi Dau system will supply 1,000 ha of mango, 592 ha of miscellaneous crops and 1,200 ha of rice while the Cam Ranh system will supply 3,000 ha of mango and 270 ha of rice.
* Crop water requirements for mango and rice have been estimated at 0.98 l/s/ha and 1.39 l/s/ha.

Figure 1: Location of the Subproject

Không thấy thể hiện các hồ chứa ???



### Gravity Canal System Designs

* For the design duties, the maximum required design diversion discharges are 3.23 m3/s (Suoi Dau) and 3.64 m3/s (Cam Ranh).
* However, the Suoi Dau north (4.4 km) and south (8.73 km) main canals were originally designed for 1.0 m3/s and 5.2 m3/s and Cam Ranh north (1.5 km) and south (18.3 km) main canals for about 0.9 m3/s and 3.1 m3/s respectively. The existing main canals have more discharge capacity than required.
* The existing main canals are trapezoidal, 80 mm thick concrete lined, except for some buried flume sections. The Cam Ranh north main canal has been abandoned and the area is now supplied by the Suoi Dau south main canal. The Cam Ranh south main canal conveyance losses are currently very high as the lining is in poor condition and 8.1 km passes through sandy soils.
* The subproject will demolish 15.3 km of concrete trapezoidal lining and replace it with reinforced concrete flume sections with 150 mm thick walls and with a reinforced concrete cover slab 100 mm thick. Design discharges will also be reduced in line with proposed crop areas. Although bridges are in reasonabley good condition, many of them (about 30) would have to be demolished and replaced to fit the new flume canal section. Details are summarized in Table 2. No work will be done for the 59 secondary and smaller canals, other than to provide new turnout gates

Table 1: Summary of Canal Structures

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Length of Main Canal (m) | Length to be Rehabilitated (m) | Turnouts | Checks | Structures, No. | | | Overflow Spillways | | Inverted Siphons | |
| Siphons/ Aqueducts | | Bridges |
| **Suoi Dau North Canal** | | | | | | | | | | |
| 4,397 Flume for first 429 m, then trapezoidal | 3,968 (KM 0.429 to KM 4.397) | 15  (missing/ damaged gates) | 1  (missing/ damaged gates) | 3 | | 12 | 2 | | 10 | |
| Mostly in reasonable/ good condition. If flume section adopted bridges would have to be replaced | | | | | | |
| **Suoi Dau South Canal** | | | | | | | | | | |
| 8,734 Flume for 1,465 m & trapezoidal for 7,269 | 3,300 (KM 4.268 to KM 7.568) | 17  (missing/ damaged gates) | 5  (missing/ damaged gates) | 6 | | 23 | 2 | | 17 | |
| Mostly in reasonable/ good condition. If flume section adopted 12 bridges would have to be replaced | | | | | | |
| **Cam Ranh South Canal** | | | | | | | | | | |
| 18,300 Trapezoidal (8.07 km passes through sands) | 8,083 (KM 0 to KM 8.835) | 27  (missing/ damaged gates) | 1  (missing/ damaged gates) | 7 | 12 | | | 4 | | 4 |
| Mostly in reasonable/ good condition. If flume section adopted 12 bridges would have to be replaced | | | | | | |
| **TOTAL** | **15,351** | **59** | **7** | **16** | **47** | | | **8** | | **31** |

* The main canal banks are largely unpaved sandy tracks. Inspections and farmer access would benefit from a paved road along one side of the main canals. Farmers would also benefit from improved access. The length of paved road required is 31.43 km that can be contemplated subject to funding availability.

### Detailed Design Requirements - Main Canals

* A cheaper alternative would be for the existing trapezoidal sections to be improved by: (i) repair of broken sections, and (ii) use of concrete protected liner to seal the canal. The canals should not be covered except in built up areas, or where necessary to prevent sediment ingress. For the trapezoidal option, if the existing canal section is too big, it should not be reduced. The existing section may just be repaired and a new liner constructed to minimize seepage. As farmers prefer to pump and irrigate mango in the early morning and evening, an overlarge canal would also provide buffer storage which would be helpful in balancing supply and demand.
* At detailed design stage, the alternatives of new flumes and rehabilitated trapezoidal options should, therefore, be compared and charged separately for the Suoi Dau north and south main canals and the Cam Ranh south main canal. New flumes might be adopted for some lengths and rehabilitated trapezoidal sections for others.
* Paved inspection roads along the main canals are desirable, but if funds are short this aspect of the proposed works may be cut/reduced.

### Pumped Pipe Designs

* The subproject will build five subsystems with pumping stations and ring main distribution pipelines to meet the adopted level of irrigation service. The proposed pumped pipe system layouts are shown in Annex 2. The associated level of service is presented in Table 2.

Table 2: Levels of Service to Mango Areas

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Subsystem** |  |  | **Access to Water (ha)** | |  |
| **Type** | **Name** | **< 250 m** | **Inter** | **> 500 m** | **Total** |
| Canal Systems | SD | 117 | 141 | 337 | 595 |
| CR | 241 | 248 | 950 | 1,439 |
|  | **Total** | **358** | **389** | **1,287** | **2,034** |
| **Canal** | **%** | **18** | **19** | **63** | **100** |
| Piped Systems | SD | 223 | 135 | 47 | 405 |
| CR1 | 213 | 184 | 163 | 560 |
| CR2 | 257 | 191 | 52 | 500 |
| CR3 | 173 | 91 | 40 | 304 |
| CR4 | 97 | 67 | 33 | 197 |
|  | **Total** | **963** | **668** | **335** | **1,966** |
| **Piped** | **%** | **49** | **34** | **17** | **100** |
| **Total** | **ha** | **1,321** | **1,057** | **1,622** | **4,000** |
| **Total** | **%** | **33** | **26** | **41** | **100** |

* The five piped subsystems involve 38.45 km of pipe, ranging in nominal diameter from 75 mm to 450 mm, to supply 1,966 ha of mango at an average pipe density of 19.6 m/ha. The mango area to be served by the piped system (1,966 ha) will have a much higher level of service than the mango area served only by the canal system (2,034 ha) (shown in Table 3). Access to water will be:

• Within 250 m for 963 ha (49%), between 250 m and 500 m for 668 ha (34%) and beyond 500 m for 335 ha (17%) in the mango area served by the pumped pipe system; and

• Within 250 m for 358 ha (18%), between 250 m and 500 m for 389 ha (19%) and beyond 500 m for 1,287 ha in the mango area to be supplied directly from main canals.

Table 3: Summary of Piped Subsystem Designs

| **Pipe Ø**  **(mm)** | **Piped Subsystem** | | | | |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Unit** | **SD** | **CR1** | **CR2** | **CR3** | **CR4** |
| 75 | m | 963 | 0 | 0 | 0 | 0 |
| 110 | m | 481 | 1,539 | 1,216 | 512 | 464 |
| 160 | m | 1,444 | 736 | 441 | 512 | 929 |
| 200 | m | 963 | 529 | 499 | 2,501 | 464 |
| 250 | m | 1,926 | 1,010 | 1,720 | 2,883 | 1,393 |
| 315 | m | 1,444 | 2,144 | 1,496 | 547 | 1,857 |
| 355 | m | 0 | 1,264 | 1,995 | 0 | 0 |
| 400 | m | 0 | 399 | 998 | 866 | 201 |
| 450 | m | 75 | 1,734 | 308 | 0 | 0 |
| **Length** | **m** | **7,296** | **9,355** | **8,673** | **7,821** | **5,308** |
| **Area** | **ha** | **405** | **560** | **500** | **304** | **197** |
| **Density** | **m/ha** | **10.0** | **16.7** | **17.3** | **25.7** | **26.9** |

* Three centrifugal electric pumps are proposed for each pumped pipe system, one being standby. Pump houses shall be provided for pump security, and to house control and monitoring systems. Three-phase electric connections shall be provided, complete with transformers, switches, lightning arrestors and so on. General arrangement drawings of the pump houses, together with intake and small pumping reservoir.
* Consistent with the modern level of service standards, the project will equip the five piped subsystems with 385 standard hydrant manifolds each with a 5 l/s design discharge. Therefore, the total design discharge of the 385 hydrant manifolds is 385 hydrant manifolds (HM) x 5 l/s/HM = 1,925 l/s, which is the same as the total design discharge of the five pumped pipe irrigation systems serving 1,966 ha x 0.98 l/s/ha for mango = 1,927 l/s.
* The unit cost of simple PVC hydrant manifolds is about $435 (80 mm diameter) or $320 (63 mm). Therefore, the maximum total cost of 385 hydrant manifolds will be $167,475, which is only $85 per ha over the service area of 1,966 ha. The average spacing of HMs will be 100 m. Each HM will serve about six households.

### Detailed Design Requirements - Pumped Piped Systems

* The design flows for each of the five pumped systems are based on 0.98 l/s/ha with adjustments for desirable flexibility, and likely farmer takes up (willingness to connect and pay for water). The required capacity shall be reassessed at detailed design.
* The proposed intake and pumping arrangements are rather more expensive than necessary, as well as taking up considerable land with room for stores and an office. Adopting a slightly more modest layout and design may be considered.
* Adoption of centrifugal pumps and/ or variable flow pumps may be considered. Also, electrical works provide necessary three-phase power need more accurate design and costing.
* The service areas and pipeline layouts should be checked/further assessed to improve the inequities in the distances from farmers field-to-pipe hydrants inherent in the present pipe system designs. Also, and more importantly, efforts to address the inequities between supply level of service between mango areas served by the main canals and mango areas served by the new pumped ring main systems should be made. This may require further to the command areas and numbers of the pump-pipe systems.

### Management and Operations

* A simple SCADA system would facilitate efficient operations by the irrigation management company (IMC) and/or private operator responsible for the pipe systems.
* For the canal systems, water levels shall be motored remotely in the tail of the main canals, in the sumps where water is pumped into the five pump systems, and also possibly at the seven check structures using both pressure and ultrasonic sensors. This dual measurement safeguards against equipment errors with an alarm sounding if readings are different. The levels would be relayed to a control office over the cellular network or Global System for Mobile Communications (GSM), stored on a computer, and used to adjust flow releases to the main canals from the reservoirs.
* Manual gate adjustment is proposed under the project, though gate actuators for remote operation could be fitted later.
* To measure flows, water level gauges could be installed in flume structures located at the head of each main canal with data also transmitted to the control office.
* For the five pumped pipe systems, devices would be installed so that pump operations are linked to pipeline pressures. Also, devices could be installed to ensure against pipe fracture during pump start-up or shutdown. This function may be performed by gradual opening/closure of valves. Control valves would be installed at the pump stations, and possibly at a few key locations in the pipe systems to allow pipe branches to be isolated for maintenance, in the case of pipe leak/burst. Operations would also be monitored, and in the event of problems, including pipeline fracture or leaks, the pumps would automatically shut down. Pipe flows could be metered using clamp-on ultrasonic digital meters fixed around the pipes at the pump stations. These operate by battery. Meters will also be installed at each hydrant. Data will be transmitted over the GSM network and stored on a computer at the control office.
* In addition to the above, meters could be installed at manifolds so that farmers become more aware of the volume of water they each use and subsequently pay for same. These meters could be cheap (mechanical) meters read manually. An alternative could be to install pre-paid meters, though the high cost of these would limit them to hydrant flows.
* With the five pumping stations, there is a clear need for good scheme operation and maintenance. Such arrangements require some management oversight and an emergency response mechanism in the event of pressure failure. Operational requirements are needed to operate and maintain pumps and respond to burst pipes or failed valves, and may best be undertaken by a private operator under a public-private-partnership (PPP) whereby the operator would collect a service fee from beneficiary farmers.
* Those farmers wishing to use high-pressure application technologies, drip or sprinkler, may need to re-pressurize at the off-take point to raise the level of the head as required (at the individual cost of the farmer).

## Total investment cost, funding sources and financial arrangement:

### Total investment amount (6 và 7 là đánh theo mục B ???)

* According to the memorandum of March 2016, the subproject shall provide financial support for investment items from key works to irrigation management transfer points of WUGs, cost components supported by the subproject. The project includes:
* Costs for site clearance and compensation are paid to:

+ Compensation for long-term land acquisition of pumping stations and water pipelines;

+ Compensation for temporary land acquisition during construction;

+ Compensation for assets on land including infrastructure, houses, trees, crops...;

+ Support resettlement, fixed cultivation, stable production and daily life;

+ Costs for making compensation, support and resettlement plans,fixed cultivation;

* Cost of implementing clearance and compensation. Construction costs are paidfor construction preparation costs (clearing, clearing the ground);construction of construction items(solidifying degraded canal sections, pumping stations and water pipelines), construction of camps and temporary works for construction.
* Equipment costs are paid for water level gauges, water pipelines, pumps and control devices, transformer stations for pumping stations.
* Project management costs paid for the organization of managing the implementation of project management jobs from the project preparation phase and project implementation to the completion and acceptance of the project, putting the work into utilization.
* The consulting costs will cover the preparation phase and the project implementation phase, including the cost of survey, design, phase verification, monitoring and verification.
* Other costs to pay for detection and destruction of boms, mines and explosive objects; construction insurance; construction deformation monitoring; audit, verification and approval of investment capital settlement; fees and charges as prescribed.
* Contingency cost includes volume and contingency provisions during construction.

Table 4: Total approved investment

| No. | CONTENT | VND | | USD | | |
| --- | --- | --- | --- | --- | --- | --- |
| Loan | Conterpart  fund | Value After Tax | Loan | Counterpartfund |
| **I** | **COMPONENT 2:** | **334,991,000** | **75,109,000** | **18,046,019** | **14,732,580** | **3,313,439** |
| I.1 | Cost of site clearance and compensation |  | 16,700,000 | 738,938 |  | 738,938 |
| I.2 | Cost of construction | 239,676,241 | 23,967,624 | 11,665,658 | 10,605,143 | 1,060,514 |
| I.3 | Cost of equipment | 32,450,068 | 3,245,007 | 1,579,428 | 1,435,844 | 143,584 |
| I.4 | Cost of project management |  | 4,849,291 | 214,570 |  | 214,570 |
| I.5 | Cost of construction consultancy | 12,671,215 | 7,473,891 | 891,376 | 560,673 | 330,703 |
| I.6 | Other costs | 16,636,786 | 7,618,713 | 1,073,252 | 736,141 | 337,111 |
| I.7 | Contingency cost | 33,556,464 | 2,434,536 | 1,492,522 | 1,394,779 | 97,743 |
| I.8 | Loan interest |  | 8,820,185 | 390,274 |  | 390,274 |
| **II** | **COMPONENT 3:** | **1,636,364** | **163,636** | **79,646** | **72,405** | **7,241** |
| **III** | **SHARE ACTIVITY FOR 5 PROVINCES** | **6,961,673** | **2,538,327** | **420,354** | **308,039** | **112,315** |
|  | **TOTAL** | **343,589,000** | **77,811,000** | **18,546,020** | **15,113,024** | **3,432,990** |

### Sponsor Fund (Donation Fund)

- Loan from Asian Development Fund by The Asian Development Bank (ADB);

- Counterpartfund by Government of Vietnam as the budget fund at local province (Khanh Hoa province).

#### As for the loan

* Total loan amount (ADB) is 15.113 million USD, equivalent to 343.59 billion VND;

In which:

+ Central budget allocates 50% of the total loan, equivalent to 371.53 billion VND, about 7.60 million USD;

+ Local budget re-lends 50% of the total loan, equivalent to 371.53 billion VND, about 7.60 million USD.

#### As for counterpart fund:

- The counterpart fund is 77.812 billion VND, equivalent to 3.443 million USD.

# Objectives and Scope, Tasks of Consulting Services

## Objectives

Objectives of consulting services are to prepare the Detailed Engineering Design for upgrading and improving Cam Ranh and Suoi Dau irigation systems based upon the WEIDAP Guidelines for Detailed Engineering Design, and in order for facilitating O&M, climate resilience and water productivity in agriculture improved, Irrigation management services strengthened (Output 1) and Efficient on-farm water management practices adopted (Output 3).

## Scope of Consulting Services

The Scope of Consulting Services consists of, but not limited to the following:

* Studying further and Identifying, Proposing modifications/ options/solutions for improving the feasibility study level designs.
* Supporting Khanh Hoa PPMU to carry out necessary surveys.
* Preparing the detailed engineering design documents for the Subproject.
* Supporting the Khanh Hoa PPMU in the process of submission and explanation ofexaminations and evaluation comments.
* Attending the study tour in Australia to visit the systems in the Riverland region of South Australia where the policy and institutional framework has been established, to increase water use efficiency in agriculture and developed pressure piping systems and/or water-saving irrigation technologies to be installed in the system.
* Organizing design workshops to report design options and consult the experts.
* Cooperate closely with the project implementation support consultants, if recruited/ appointed.
* Regularly reporting the work progress to the Khanh Hoa PPMU.
* Providing the oversight of the detailed engineering design authors’ right, etc.

## Specific Tasks of the Detailed Engineering Design

### Studying further and Identifying, proposing modifications/ options/ solutions for improving the feasibility study level designs

* **Construction sites and solutions:** Construction sites and solutions were suggested during the feasibility study phase. At the detailed engineering design, when the basic documents are collected, more detailed and full surveys will be needed for confirming the optimization of the selected locations and solutions. In case of any changes in the investment project preparation phase, there must be a valid argument. Also, basic documents/ data from the surveys and designed works must allow to ensures sufficient volume components
* For the pumped pipe systems, the pumped pipe system service (command) areas should be further refined to ensure that only HVCs (mango) areas are included. Rice (valley) areas should be excluded.
* Direct pumping into a main pipeline of a pressurized pipe system. As part of the detailed engineering design. Pressurized pipe (ring) systems shall be adopted. A single small header tank may be located at the highest (and furthest) location in each pipe system, with pressures (or water levels) triggering pump operations. Alternatively, pump operations may be controlled by pressure sensors in the pipeline.

### Collecting hydro-meteorological data, conducting topographic and geological data surveys

* On the business of detailed engineering design, additional topographic and geological surveys, hydrogeological works and other data are required. All work must comply with relevant technical standards, regulations and norms.
* The purpose of construction survey work aims to provide topographic, geological, meteorological and hydrological documents for the design of the technical design phase of construction of pumping stations and primary irrigation.
* The consultant should base on the quantity of meteorological, topographic and geological documents surveyed in the previous period to propose additional survey tasks in accordance with the accuracy requirements of documents in construction engineering design stage.

### Evaluating current available documents to propose necessary survey activities

* Control of the surface at class IV, grade 2, coordinate system VN2000, control of the height of class IV - Hon Dau (Hai Phong) in accordance with current standards: Re-using the surface control and altitude has been implemented during the F/S phase to deploy the entire measurement area.
* The detailed engineering design will reuse the available topographic maps, including:

+ Topographic map in scale of 1/500 with 0.5m contour line in the area of headworks, water storage tank and management office;

+ Topographic map in scale of 1/1000 with 1.0m contour line in the area of pipeline systems;

* For topographic map of the roads for management and pipeline system, the F/S phase has not yet implemented. So, in the detailed technical design, it is necessary to measure the topographic map of 1/1000 with 1.0m contour line.
* For longitudinal sections, cross-sectiond of construction items that have not been implemented in the period phase of the sub-project, they will be measuredin the detailed technical design.
* Plugging the center of the works, monitoring benchmarks, and land clearance boundariesthat have not been implemented in the period phase of the sub-project, they will be measuredin the detailed technical design.

### Identifying components and quantity of topographic survey work in the detailed engineering design

#### Data collection

* The work of collecting data is an important task which help the consultant have enough data to analyze and calculate in order to provide reasonable solutions when conducting surveys and technical design of construction details and construction works:
* Data to be collected in the period of detailed engineering design include:

+ Topographic maps of all kinds of structure (pipelines, pumping stations, water storage tanks, canals and main pipelines).

+ Documents on control points (coordinates, altitudes, benchmarks).

+ Other relevant survey materials.

#### Identifying quantity of all topographic survey work items

* Horizontal control network: The horizontal control network in this phase is only built for measuring scale of 1/1000 with 1.0m contour line at the locations of materialyeard.
* Technical leveling: The technical leveling is guided from the traverse network - grade 1 set up in the previous phase to the station points for the measurement of the topographic section of the construction items.
* Topography of material yards at the scale of 1/1000 and contour line h= 1.0m. The location of material yards handed over in the field by the geological survey team leader, the areas for earth embankment and the works must be surveyed to determine the area and boundaries of crops.
* Topography of benefit area

+ Detailed engineering design consulting unit reviews and updates the survey data on the position map, the map shows the pipeline, irrigation canal and combined with the longitudinal and cross-section measurement data in the period serves the detailed design work.

+ Proposing proposals if necessary.

* Measuring longitudinal section: Measuring scope includes the system carrying water from the reservoir to the station, power lines, main pipelines, irrigation pipeline and the roads for management.
* Measuring cross section: Cross-section measurement range includes the system carrying water from the reservoir to the station, the main pipeline, irrigation pipeline and the the roads for management.
* Plugging the center of the works: Installation of work items includes the beginning and the end points and the turning points.
* Determination of the boundary of land clearance: The benchmark system is to determine the boundary of land clearance. It is necessary to define the boundary of the system carrying water from the reservoir to the station, pumping station, water storage tank, power line, feeder pipeline, main pipeline, irrigation pipeline and the roads for management ... for site clearance, make compensation fund.
* Ground accuracy determined by accuracy of grade 2.
* Height accuracy determined according to technical leveling.
* Benchmark size is 10x10x60cm concrete column with name and code number.

### Identifying components and quantity of geological survey work in the detailed engineering design

#### Collecting documents

- The existing documents of the items are only guaranteed to be evaluated at the locations with boreholes and excavation surveys. The distance and the number of survey positions does not guarantee the assessment for the entire route. During this phase, additional surveys are needed at the locations of pumping stations, water storage tanks, discharge pipelines, main pipelines irrigation pipelines and the roads for management.

#### Identifying quantity of geological survey items.

* Digging the survey pit

- Excavation work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

- The distance between excavated pits in the centerline of the pipeline is usually from 50 m to 75 m (at each of the abutments of the pressure pipe, manholes should have at least one survey pit) with a depth lower than the foundation expected process from 1m to 2m (or in medium weathered rock zone from 1 m to 2 m).

- The distance between excavated pits in the centerline of the road is 500 m. The depth of the surveyed pits must be deeper than the foundation expected from 2m to 3m.

- For mountainous canals with a flow of Q ≥ 0.5m3/s, the distance of boreholes along the centerline of the canal is 100m to 200m/hole. The depth of boreholes, pit and pierced through the centerline of the canal should be lower than the canal bottom from 2m to 5m. In case the canal bottom is in soft and weak layer, the survey depth must pass that layer from 1m to 2m. If the weak soft layer is too thick, the survey depth must be greater than 2b (b is the width of the canal bank bottom) and greater than 1.5h (h is the height of the canal).

* Drilling work

- Drilling work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

- The depth of boreholes must pass the foundation level of the works from 3 m to 10 m and greater than 1.5B (with B as the foundation width).

- In case of encountering soft soil layer, there must be at least 1 hole to pass through soft soil layer and into a good soil layer below that not less than 2 m. In all cases, the depth of borehole does not exceed 15 times of S (with S as the depth of foundation buried from its bottom elevation). In case of encountering ancient alluvial layer, the depth of borehole must be deep into this layer of 5 m to 7 m.In case of encountering rock, this value is from 3 m to 5 m.

- Drilling work is arranged at pumping stations, water storage tanks. The F/S phase was surveyed with each location of 1 to 2 drill holes. In this phase, boreholes should be arranged at positions not yet surveyed.

* Surveying at material yard

Each material yard is expected to dig 3 pits.Each pit has a distance of 200m each and 4m deep. It is expected that each area will survey 01 material yard. The digging volume is as 7 areas x 3 pits/ area x 4m = 84m.

* Standard penetration test (SPT)

- SPT testing aims to serve the calculation of the soil bearing capacity, to check the status and structure of soil at the site, to be carried out in top soil and strong weathering rock layers.

- This testing is performed in the boreholes at the pumping station and water storage tank locations.

- Pursuant to TCVN 8477: 2010 - 7.3.3.6 In-room and outdoor testings - Standard Penetration test (SPT) in the remaining soil layers under the works. At each soil layer there are no less than 05 SPT values. Expected to have 3 layers of soil and volume of 15 times.

* Testing sample with 9 criteria

- The testing sample with 9 criteria is to provide physical and mechanical parameter to serve the calculation of the stability of the works.

- Samples are taken in boreholes andpit. Samples to be taken must be representative of the entire stratum of the survey.

- Based on TCVN 8477: 2010 - 7.3.4. Main waterways: canal routes, tunnels (tunnels), water pipelines and river bank protection embankments, 7.3.4.3 Water tunnel, water pipeline, pressure pipe and 7.3.5 Other works: Hydroelectric power plants, power distribution stations, management office, road serving for construction and electric lines. Testing soil samples from 6 to 10 samples each.

* Testing rock samples

- The purpose is to determine the compressive resistance intensity of rock samples in natural state and saturated state.

- Samples are taken in boreholes at pumping station and water storage tank locations. It is expected to have 1 weathered rock layer / 1 hole, 1 sample for each hole.

- Total rock samples is 2 samples.

* Testing to determine standard compaction criteria, soil properties of material yards

- Samples are taken at material yard locations. The sample is non-intact. Serving the earthworks at the lower elevations than the required elevation, each material yard is expected to have 1 usable layer of soil, each layer will take 3 compaction samples, 3 prepared samples. Survey quantity is as follows:

- Standard compaction model: 24 samples

- Preparation testing: 24 samples.

### Participate in Study Tour in Australia

* A study tour will be held after recruiting Consultants for all subprojects.
* The trip aims to learn about modern irrigation system in the Riverland (Riverland Region) of South Australia. The trip is sponsored by the Australian Water Partnership (AWP).
* After the trip, the Consultant should give a report on the experiences learned and applied in the design of the Irrigation System of the Cam Ranh - Suoi Dau subproject (Cam Ranh - Suoi Dau subproject)

### Preparing the detailed engineering design

#### Checking Required hydrological and irrigation calculations

- Check and evaluate the calculation data in the phase of preparing the FS report;

- Irrigation calculations are carried out for engineering items, pumping stations, hydraulic pressure pipes and dams, canal systems and related items to determine/confirm the size of items as well as to evaluate options/technical solutions to improve/modify FS level design.

# The design flows for each of the pumped pipe systems are based on 1.04 l/s/ha TẠI SAO ??? . The required capacity may be reassessed/ confirmed at detailed engineering design.

#### Requirements for hydraulic work calculations of pressurized pipeline systems

- Hydraulic diagram and software for hydraulic calculations: Calculation of hydraulic works of focal points; calculating hydraulic piping hydraulic by EPANET or WaterGems software unless other is approved.

- Outputs of hydraulic problems: Determination of size and elevation of intake pump tank, pipeline, push pipe; determine the size of the irrigation pipe.

#### Requirements for calculations of the detailed engineering design

Design solutions have been studied and calculated at the FS level to select the specifications of Pump Stations and Pipeline System. In addition, requirements for calculation of detailed engineering design are supplemented as follows:

* SCADA systems

- SCADA systems shall allow remote monitoring of water levels, pressures, flows and water meter reading data at appropriate points in the reservoir, on pipeline and open channel systems, in the main pipeline leading from the pumping stations, at all/ hydrants. Pumping stations shall also be monitored. The operation of the pumps shall be linked to pipe pressures.

- SCADA systems shall link the pumping stations, monitoring stations at the fields, the water measurement system and the central control office via the Internet and the 4G/ 5G universal mobile telecommunication system (UMTS) or the latest mobile technology. The central office shall be located, rehabilitated and equipped as required with server/ computer/ devices/ Internet/ UMTS connections, software, databases and so on.

- At the detailed engineering design, the consultants shall consider further:

(i) Real time SCADA and applications of Internet of Things (IoT) technology shall be considered;

(ii) The Websocket protocol/ technology shall be applied for real time SCADA systems;

(iii) SQL Server and ArcGIS databases will be very useful for control and management as well as maintenance of pressure pipe systems, etc.

* Electricity supplied to the station

- A suspended or on-ground substation will be located in the area of management and operation. The capacity of the station must be calculated to ensure the operation of the pumping station.

- Connection: The connection point is taken at the local medium voltage line passing through the pump station area and there must be an approved connection dossier. Medium voltage 22 kV transmission line will be built from the connection point to the substation.

* General requirements for hydraulic calculation and design

- Check and repair structural items, design criteria and design standards of approved items in previous periods;

- Confirm the optimization of the tasks and measures of items identified in the investment project;

- Carry out additional design work to improve the technical works that are determined to be feasible: In case of need to adjust and supplement the tasks and structural measures of the project, it is necessary to recalculate and redefine requests for items in order to have explanations for such adjustments and additions;

- For the proposed technical solutions, it is necessary to study and find solutions to treat the ground in accordance with the geological conditions, select the size of the structure and measures according to the principle of making the best use of the local materials and easy construction;

- Design and accurately arrange the layout of the main items, including pumping stations, power stations, low voltage lines, intake sump tanks, push pipes and discharge tanks, canals, input items, pipelines and related items according to the landscape architecture planning for works and in line with the road system, in the subproject area;

- Review the location choices of items in the previous phase in the subproject area to select the optimal location;

+ Basis of choice: Characteristics of categories, natural and social conditions, management requirements...

+ Selecting places to design;

+ The overall layout of items according to each location's options;

+ Possibility of land acquisition and resettlement (if any);

+ Determining the basic size of items;

+ Calculation and analysis to select the optimal category position.

- Select and approve on the best technical plan: Technical plans will be presented and approved by the relevant authorities as prescribed, then the detailed engineering design will be carried out. Based on the approved basic design in the preparation of the Feasibility Study Report, adjustments and additions to the project's structural tasks and measures (if any) and the optimal structural location select and give the main part of the pumping station: Based on the approved items in the step of preparing the feasibility study report, adjustments and supplements to the tasks and structural measures of the project (if yes) and the optimal category position is selected, to calculate and select the optimal size and item of the works, item details and categories and items and select the optimal solution for foundation treatment.

- Check to correct the ratio and basic dimensions of the structures, calculate the stability of the structures.

- Calculate the stability of items of pump houses, suction tanks, propellers, water storage tanks, managers, roads and other auxiliary facilities.

#### Requirements for roads and management office

* Requirements for traffic roads

- Determine the cross section for the road according to rural road standards - design requirements: TCVN10380-2014.

- Visits to review the current status of the road to serve the design requirements based on the following principles:

+ The road must meet favorable connection with existing roads and construction items, serving for project management and operation.

+ Considerate to make full use of the existing road and construction road to upgrade and expand to meet the design requirements before new construction.

+ Must take advantage of the available local materials (or on-site materials) into the road and structure.

- Regarding the roadbed compaction level, permissible settlement of the road bed must comply with current standards.

- Crossroads at intersections and crossroads need to be arranged with curved radius in accordance with the standard to ensure visibility for vehicles to run.

- Signage pile system, road markings, protective guardrails, and metal structure detailed drawings (if any).

* Requirements for management stations

- Determining main items, service area to meet management requirements.

- Reasonable and convenient location for stations to connect with the main works.

- Designed in accordance with local architecture and regional landscape to meet requirements.

* Requirements for Access roads

- For access roads, at least to reach the pumping stations, shall be designed and costed.

* Requirements for mechanical designs

- Assign requirements to calculate and select items of lifting equipment including location, structure size of lifting equipment for each structure; calculating lift, lowering force and lifting equipment for buildings;

- Select type and layout of crane structure in pumping stations.

- Calculation and selection of materials for water pipeline (steel, HDPE), pipe thickness.

* Requirements for electrical design
* It is necessary to calculate the power load of the project (pumping station, manager), the load for the construction work (the whole construction site) as a basis for asking the power source and connection point, and working with the Electricity Company. Local to locate the connection point, voltage level and the length of the power line to operate the project management and provide electricity for construction.
* Design and calculate the main items and set up premises and records of power supply lines for the work of pumping stations, including traverse lines and substations.
* Electrical works to provide necessary 3-phase power to each pump station need more accurate design and costing.
* Low voltage system design including main electrical connection diagram; Engine control, measurement and protection diagrams to open and close pumping stations, diagrams of monitoring and communication systems, lightning protection systems and grounding systems.
* Requirements on design of construction organization and construction method.
* Optimal method of exploiting and transporting construction materials.
* Method of construction of main works;
* Construction quality control measures;
* Fire and explosion prevention, and labor safety;
* Environmental protection during construction;
* Transportation inside and outside the construction site;
* Auxiliary facilities (factories, camps ...) and systems to provide electricity, water, and communications for construction and on-site activities;
* Total construction ground general construction progress;
* Provide main materials and equipment for the project;
* Navigation diagrams and construction by year;
* Measures to prevent flow (specifications and volume of materials;
* Construction method of structure;
* Planning and using construction materials;
* Other necessary drawings.
* Requirements for construction cost estimates
* The consultants will study the basic construction unit prices in the locality, the norms of basic construction costs, the current regime and policies of the state and the province in terms of capital construction, make a summary table of volumes and a detailed forecast, and cost estimates for the works and the total cost of the subproject.
* Requirements for operational development and maintenance guidelines
* In order to develop processes for operation, management, exploitation, maintenance and protection of buildings, including:
* Instructions on O&M;
* Detailed scope of protection and management;
* Details of the item and architecture of the project to serve the operation and protection management of the project;
* Details of the monitoring and control network;
* Details of the communication system;
* The exact number and quantity of equipment and construction operation management system;
* Update resettlement plan
* Based on the resettlement plan, it is required to set up in the project investment phase, the consultants will update minor changes in the pipeline and canal design during the detailed design process, so that the plan is re- implemented. Settlement must be updated in accordance with technical amendments.
* Prepare an environmental management plan (EMP)
* Items and contents of the EMP of the project must be in accordance with Annex 2.10 in Circular No.27/2015/TT-BTNMT dated on 29/05/2015 issued by the Minister of Natural Resources and Environment on environmental assessment, strategies, environmental impact assessments and environmental protection plans. The main content is as follows:
* Measures and plans to minimize negative impacts on the environment during the preparation phase (if any) and the project construction phase, including:
* Minimize negative impacts on the surface water environment (if any)
* Minimize negative impacts on groundwater environment (if any);
* Minimize negative impacts on the air environment (if any);
* Minimize bad impacts due to noise and vibration (if any);
* Minimize negative impacts on the community (if any);
* Collection, temporary storage, transportation and disposal of waste;
* Minimize other negative impacts (if any).
* Planning to build environmental protection items for the operation phase of the project (if any), including:
* Wastewater treatment works; Water treatment factory; Waste treatment works;
* Projects for storing and treating ordinary solid wastes and hazardous wastes;
* Plan for construction and installation of other environmental protection projects: The content of construction plans and installation of environmental protection works for the operation phase of the project must clearly show the expected construction time, installation and finishing.
* Environmental monitoring program during the construction phase of the project: The content of the environmental monitoring program should clearly state the monitoring position, monitoring frequency, monitoring parameters and technical standards and regulationsapplied to assess environmental sample quality with approved sampling locations in environmental impact assessment reports

### Acquire the comments and complete the Detailed Engineering Design

* Prepare a report explaining the comments of related parties in the Design Workshop and adjust the Detailed Engineering Design according to the opinions of the parties in the Design Workshop and the opinions of the Detailed Design Verification Consultant.
* A Technical Design Workshop will be organized after recruiting Consultants. The workshop will involve related parties including consultants, PPMUs, PPC representatives, experts, operational management units, and representatives of the people who are benefited from the project.
* The meeting will provide critical feedbacks from the parties, the Consultant will present about DED, acquire comments to adjust DED if the comments are appropriate.

### Present the content of the Detailed Engineering Design in the meeting held by PPC.

* After receiving appraisal opinions of the agencies under PPC, PPC will hold a meeting to discuss about DED. During the meeting, the Consultant will present about DED, explain the comments in the meeting and adjust the DED according to those comments.
* Complete the Detailed Engineering Design for approval

### Requirements for supervision of the detailed engineering design authors’right.

* The consultant is responsible for conducting supervision of the authors’right according to the current regulations (Decree 46/2015/ND-CP on quality management and construction maintenance).
* Appointing the qualified people to supervise the authors’right during the construction process. The main tasks are as follows: responsible for explaining and clarifying construction design documents to the Investor and other contractors for management and construction in accordance with the design; modify the design for the content which is not consistent with the actual standards and conditions of the project; detect errors compared to the design;

## Essential Documents attached to the TOR needing to be observed and referred

### The Guidelines for Detailed Engineering Design

* The Guidelines for Detailed Engineering Design (Revised version 2019) is prepared to guide the detailed engineering design process, for use by MARD, DARDs, SPPMUs/PPMUs involved in the WEIDAP Project, and ADB, AWP, and will be included/ attached to the Terms of Reference for the procurement of services for detailed engineering designs with support from CPO/CPMU.
* The Guidelines, which give the Key Design Principles for design of the Subprojects as well as specific guidance for Subrojects in each Province, shall be observed by the detailed engineering design consultants.
* The Guidelines for Detailed Engineering Design can be downloaded at: <http://onlinedroughtcontrol.com/FinalRevisedGuidelines4DED.pdf>

### The Subproject Report: Cam Ranh – Suoi Dau Subproject

* The consultants shall also review the following report when preparing the detailed engineering designs: “Subproject Report: Cam Ranh – Suoi Dau Subproject” at <https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-07.pdf>
* This report is one of the linked documents to the ADB’s Report and Recommendation to the President (RRP: VIE 49404-002) on the proposed loan, grant, and administration of grant to Viet Nam for the Water Efficiency Improvement in Drought-Affected Provinces Project.

### The Design Principles for Subprojects

* The Design Principles for Subprojects can be downloaded at: <https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-01.pdf>
* The Design Principles for Subprojects, especially the specific guidance for System Design Discharges should be referred.

### The Feasibility Study report

* The Feasibility Study for Cam Ranh – Suoi Dau Subproject was approved by Khanh Hoa Provincial People’s Committee at the Decision No. 1807/QĐ-UBND on June 22, 2018.
* The design consultants shall review the Decision and the Feasibility Study Report at : <http://onlinedroughtcontrol.com/DecisionOfCamRanh-SuoiDauPPConApprovingtheFS.pdf>, and <http://onlinedroughtcontrol.com/CamRanh-SuoiDauFeasibilityStudyReport.pdf>

# IMPLEMENTATION DURATION TIME

Consultancy services for the detailed engineering design are expected to begin just after signing the contract. Contract implementation duration is 270 days (09 months). The technical proposal of the Consultant will include an action plan with expected members of the consulting team and the progress of mobilizing experts and support staff:

+ Phase 1( From the effective date of the contract to Day 90): Researching on improving FS and geological topography, learning experience in Australia (according to the proposed plan of CPO and the Australian Water Partnership (AWP))

+ Phase 2 (Day 91 to Day 210): Carrying out the detailed design.

+ Phase 3 (Day 211 to Day 240): Organizing the Design workshop, acquiring the opinions of related parties to complete the design and submitting detailed design documents.

+ Phase 4 (Day 241 to Day 270): Coordinating with PPMU and related parties to report, explain and finalize the detailed design until it is approved.

# REPORTING REQUIREMENTS AND TIME SCHEDULE FOR SUBMISSIONS OF THE DELIVERABLES

## Reporting requirements

The dossiers of the detailed engineering design must be prepared in accordance with the relevant sectoral norms, standards, and other relevant regulations and procedures of the State, and the WEIDAP guideline for detailed engineering designs (See 3.2.3 a) ).

The main report and working papers: Composition and volume of reports must complying with the National Technical Regulation on the composition, contents of the technical design dossier and detailed engineering design of hydraulic works QCVN 04-02: 2010/BNN-PTNT.

Language of the dossiers and reports: Vietnamese and English

(i) Main report

(ii) Specific working papers:

* Topographical report: complying with the standards on topography
* Geological report: complying with the standards on geology
* Hydrometeorological - water balance report: complying with the standards on hydrometeorological and water balance
* Structure design report
* Mechanical design report
* Electric design report
* Report on construction organization and measures
* Report on operation and maintenance rules

(iii) Drawings

* Site geological engineering drawings: complying with the promulgated regulations on the composition and volume of geological survey in the project planning and design stages.
* Drawings of structure status
* Structure design drawings: showing the entire contents of a detailed design of structures, including the location, size, details of elements, layout of equipment, construction measures, and measures to protect the ecological environment, operation, management and maintenance of structures. The design drawings must show full and accurate details to allow the practical construction on site in accordance with the design requirements; honestly reflecting the contents of the approved basic designs; presenting clearly, scientifically and easily to understand in the prescribed format.
* Mechanical design drawings
* Electrical design drawings
* Design drawings for construction organization

## Time schedule for submissions of the deliverables

Table 5: Progress of submitting the deliverables

|  | **Milestone** | **Content** | **Name of dossier** |
| --- | --- | --- | --- |
| **Phase 1** | From the effective date of the contract to Day 90 | Researching on improving FS and geological topography, learning experience in Australia | (1)Topographic survey diary  (2)Topographic survey report  (3)Topographic survey processed data data  (4)Topographic survey drawings  (5)Geological survey diary  (6)Geological construction survey report  (7)Geological construction survey drawings  (8)Original testing documets  (9)Australia Study tour report |
| **Phase 2** | Day 211 to Day 240 | Organizing the Design workshop, acquiring the opinions of related parties to complete the design and submitting detailed design documents. | (10)Minutes of Design  Workshops |
| **Phase 3** | Day 91 to Day 210 | Carrying out the detailed design | (11)Hydrological and Irrigation reports  (12)Mechanical design and electricity reports  (13)Construction organisation reports  (14)Construction instruction explanation/note  (15)Detailed engineering design – cost estimates design explanation/ note  *- Calculating appendix*  *- Prognosis appendix*  (16)Technical process of O&M  (17)Hydrological and Irrigation reports  (18)Mechanical design and electricity reports  (19)Construction organisation reports  Construction instruction explanation/note  (20)Construction drawings  *-Hydraulic design drawings*  *-Pumping and pipeline design drawings*  *-Steel layout drawings*  *-Mechanical and electricity design drawing*  *-Construction organisation drawings* |
| **Phase 4** | Day 241 to Day 270 | Coordinating with PPMU and related parties to report, explain and finalize the detailed design until it is approved | Completed Detailed Engineering Design Dossier |

# QUALIFICATION REQUIREMENTS FOR CONSULTING FIRM

## Requirement for qualifications of the consultant

- The consultant must be a legal entity, or a partnership that meets the requirements of the Advisory Manual for Asian Development Bank and the Borrowers. In particular, the Consultant must meet all conditions under the current regulations; At least 10 years of experience in providing consulting services for ODA-funded projects, including those implemented by the Asian Development Bank (ADB); Consultants must have a team of experts comprising managers, experts with expertise and experience in the areas required by the project. Consultants must meet the requirements below:

- The consulting firm must meet the eligibility requirements in accordance with current regulations of Vietnam and "Guidelines on the Use of Consultants by Asian Development Bank and Its Borrowers".

- The consulting firm must be a unit with full legal status and business registration in accordance with the scope of work; with a certificate of construction consulting activity in accordance with regulations;

- The consulting firm has a strong financial capacity in the last 3 years (2016, 2017, 2018), with sufficient infrastructure and necessary equipment for surveying and designing and detailed specifications required;

- Having registered information on the National Bidding Network, having a system of quality management and organization in accordance with the current regulations of the State.

- The consultancy unit must have at least 05 years of experience and 05 consultancy contracts for project preparation, design of ODA projects and projects in the fields of Agriculture and Rural Development, water resource development and irrigation water supply. The consultancy unit must have experience and at least 03 implemented projects of similar scale and nature in planning and designing pressure irrigation supply pipe systems for HVCs/ agriculture .

- All potential consultants must attend an "information workshop" before submitting bids.

- If the Consultant is a joint venture, each member must satisfy the requirements as for independent consultant corresponding to the work undertaken.

## Requirements on qualifications of key experts:

The Consultant must mobilize qualified and experienced experts in the proposed fields and one of them will be appointed Project Manager to coordinate and implement the subproject. Note that if the positions do not overlap with respect to time, one expert may assume multiple positions. The minimum requirements on the number, qualifications and experience of key experts are as follows:

### Team leader (01 person)

Requirements: is an irrigation specialist, s/he must has a bachelor degree in irrigation construction, perferably master or higher degree, and a valid certificate with at least 15 years’ experience in the field of irrigation construction design consultancy and at least 1 implemented projects in using EPANET or WaterGems software; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Team leader will report to the IA and work consistently with other specialists and project implementation supporting staffs. S/he will perform those following tasks:

- Taking general responsible for managing consultant team, ensuring consultancy service’s progress and quality. Reporting and clarifying contents related to sub-project consultancy services to authorized agencies, international consultancy specialist and advisors supported by ADB;

- Supervising and evaluating consultant team’s performance;

- Assisting IA to cooperate with consultancy specialists from CPO, MARD and ADB during sub-project implementation and approval process.

### Deputy team leader (at least 02 people)

Requirements: at least 01 specialist in the field of irrigation works, at least 01 specialist in the field of water resource management; specialists must have an appropriate bachelor degree, perferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of irrigation construction design consultancy; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Deputy team leader is a person who directly execute consultant team based on team leader assigned, duties as following:

- Directly take responsibility and execute those specialization: responsible for survey and design results along with assigned specialization; cooperate with other specialization hosts to ensure progress and quality.

- Synthetizing data, survey – design results.

- Participating in deploying, monitoring and evaluating supporting staff team performance in topography survey of sub-project.

### Topographical specialist (at least 02 people)

Requirements: is a specialist in the field of topography survey, s/he must have university degree majoring in construction geodesy, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of irrigation construction topographical survey consultancy; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Execute survey team to implement topographic survey in accordance with the approved Survey Outline and Survey Technical Plan. Topographic specialists have the following tasks:

- Responsible for topographic survey results; Coordinate with the team leader and other specialists to carry out the topographic survey to ensure the progress and quality of consulting services;

- Syntherizing the data, reporting the survey results and hand over the landmark to the IA;

- Participating in the implementation, monitoring and evaluation of the performance of support staff in the topographic survey of the sub-project;

### Geological specialist (at least 02 people)

Requirements: is a specialist in the field of geologic survey, s/he must have university degree majoring in construction geology, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of irrigation construction geologic survey consultancy; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Execute survey team to implement geologic survey in accordance with the approved Survey Outline and Survey Technical Plan. Geologic specialists have the following tasks:

- Responsible for the results of engineering geological surveys; coordinate with the team leader and other specialists to carry out the geological survey to ensure the progress and quality of consulting services.

- Syntherizing the data, report the survey results, analyze and clarify the experimental data.

- Participating in the implementation, monitoring and evaluation of the performance of support staff in the geological survey of the sub-project;

### Hydrology, irrigation specialists (at least 02 people)

Requirements: is a specialist in the field of irrigation, s/he must have university degree majoring in construction hydrology or water resource management, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of irrigation work consultancy and at least 3 implemented projects in using EPANET or WaterGems software; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: irrigation and water balance calculation. Specialists will perform those following tasks:

- Taking overall responsibility for irrigation calculation results and water balance to ensure the progress and quality of consulting services.

- Syntherizing, reporting and clarifying the contents related to the calculation results to the team leader and authorized agencies, international consultants, advisory teams supported by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the construction drawing design of the subproject;

### Hydralic, construction specialists (at least 02 people)

Requirements: is a specialist in the field of irrigation, s/he must have university degree majoring in irrigation work, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of irrigation work consultancy; has joined ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Hydraulic, structural calculation and hydraulic work and construction design to determine the optimal scale of works. Hydraulic and construction specialists have the following tasks:

- Taking overall responsibility for the results of hydraulic calculations, hydraulic structures, construction organization methods to ensure the progress and quality of consulting services;

- Syntherizing, reporting and clarifying the contents related to the calculation results to the team leader and authorized agencies, international consultants, advisory teams supported by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the support staff in the construction drawing design of the subproject;

### Water supply specialists (at least 03 people)

Requirements: is a specialist in the field of water supply, s/he must have university degree majoring in water supply, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of water supply design consultancy; has participated in ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Calculate technical flow/pipelines in pumping stations, hydraulic calculations of pipeline networks. Water supply specialists have the following tasks:

- Taking general responsibility for the results of the pump station calculation, the hydraulic calculation of the pipeline, the organization of construction methods to ensure the progress and quality of consulting services.

- Designing technical piping for pumping stations and pipelines.

- Syntherizing, reporting and clarifing the contents related to the calculation results to the team leader and authorized agencies, international consultants, advisory teams supported by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the construction drawing design of the subproject;

### Electricity/automation specialists (at least 02 people)

Requirements: is a specialist in the field of remoting electricity design, s/he must have university degree majoring in electricity, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of remoting electricity design consultancy for pumping station works/water supply factories; has participated in ODA projects related to water supply, fluent in English will be an advantage.

Tasks: Calculate remoting electricity for pumping station. Electrical/automation specialists perform those following tasks:

- Taking overall responsibility for the results of the calculation of the electricity for the pumping station, measures to organize the construction to ensure the schedule and quality of consulting services;

- Designing remoting electricity for pumping stations;

- Syntherizing, reporting and clarifying the contents related to the calculation results to the team leader and authorized agencies, international consultants, advisory teams supported by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the construction drawing design of the subproject;

### Operating mechanic, electricity specialist (at least 02 people)

Requirements: is a specialist in the field of hydraulic mechanic and operating electricity, s/he must have university degree majoring inirrigation work, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of hydraulic mechanic equipment, lines substation design consultancy; has participated in ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Detailed design of the arrangement of hydraulic mechanical, operating electricity devices. Mechanical and operating electrical specialist perform the following tasks:

- Taking overall responsibility for the results of the calculation of the structure of hydraulic mechanic devices, the scale of the substation’s line in line with the objectives and tasks of the sub-project to ensure the progress and quality of consulting services.

- Syntherizing, reporting and clarifying the contents related to the detailed mechanical, operating electrical design for the team leader and authorized agencies, international consultants, advisory teams approved by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the construction drawing design of the sub-project;

### Transportation specialist (at least 01 person)

Requirements: is a specialist in the field of transportation, s/he must have university degree majoring inirrigation work, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of road traffic work design consultancy; has participated in ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Designing transport system associated with the subproject's work categories. Transportation specialist will perform those following tasks:

- Taking overall responsibility for the calculation results of the structure and scope of the transport work in accordance with the sub-project objectives and tasks to ensure the progress and quality of consulting services.

- Syntherizing, reporting and clarifying the contents related to the detailed design of transport works for the team leader and authorized agencies, international consultants, advisory teams supported by ADB. ;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the construction drawing design of the sub-project;

### Economic, estimation specialist (at least 02 people)

Requirements: is a specialist in the field of work construction cost estimate preparation, s/he must have university degree majoring in construction economy, preferably master or higher degree, and a valid certificate with at least 10 years’ experience in the field of preparing work construction cost estimate; has participated in ODA projects or other relevant technical projects, fluent in English will be an advantage.

Tasks: Preparing categories’ cost estimates, total construction cost estimates for the sub-project. Cost estimate economists will perform those the following tasks:

- Updating the policies, construction unit prices issued by the local government as a suitable basis for calculating the works construction estimate for the subproject to ensure the progress and quality of consulting services. .

- Reviewing and comparing the construction prognosis, syntherizing, reporting and clarifying the contents related to the work construction cost estimation with the team leader and the authorized agencies, international consultants, the advisory teams supported by ADB;

- Participating in the implementation, monitoring and evaluation of the performance of the supporting staff in the work construction cost estimation for the sub-project;

### Supporting staffs (at least 20 people) (TỔNG 12 VỊ TRÍ NHƯNG KÊ RA Ở BẢNG DƯỚI LÀ 13 ???

The consultant must mobilize a support team with experience in designing, drawing and collecting data. The mobilized support personnel should have expertise in hydraulic engineering.

Experience: Having relevant university degree and at least 3 years of experience in designing irrigation works, irrigation systems; traffic construction design.

### Summary of specialists and their work volume

Table 6: Summarized quantity and volume of consultant work per man month

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Position** | **Quantity** | **Mobilized time (man month/per)** | **Total time of mobilization (man month)** |
| 1 | Team leader | 1 | 6,0 | 6,0 |
| 2 | Deputy team leader | 2 | 5,0 | 10,0 |
| 3 | Hydrographic, irrigation specialists | 2 | 4,0 | 8,0 |
| 4 | Hyraulic, construction specialists | 2 | 5,0 | 10,0 |
| 5 | Water supply specialist | 3 | 5 | 15,0 |
| 6 | Electricity/automation specialist | 2 | 4 | 8,0 |
| 7 | Transportation specialist | 1 | 3,0 | 3,0 |
| 8 | Mechanic specialist | 1 | 3,0 | 3,0 |
| 9 | Electrical specialist | 1 | 3,0 | 3,0 |
| 10 | Cost estimate economist | 2 | 3,0 | 6,0 |
| 11 | Topographic survey specialist | 2 | 3,0 | 6,0 |
| 12 | Geological survey specialist | 2 | 3,0 | 6,0 |
| 13 | Supporting staffs | 20 | 6,0 | 90,0 |
|  | **Total:** | **41** |  | **174** |

# CONSULTANCY SERVICES COSTS

## Basic of preparing consultancy cost estimate:

* Pursuant to Circular No. 02/2015/TT-BLDTBXH dated January 12, 2015 of the Ministry of Labor - Invalids and Social Affairs stipulating salaries for domestic consultants as a basis for estimating the bidding package for providing consultancy services on the form of time-based contract using state capital;
* Pursuant to Circular No. 40/2017/TT-BTC of the Ministry of Finance dated April 28, 2017, stipulating business trip allowances and conference costs applicable to state agencies, public and non-business units, political organizations, socio-political organizations and associations using state budget funds;
* Pursuant to Decision No. 79/QD-BXD dated February 15, 2017 defining the norms of project management costs and construction investment consultancy;
* Pursuant to Circular No.17/2013/TT-BXD of Ministry of Construction dated October 30, 2013 guiding determining and managing construction survey costs;
* Pursuant to Circular No. 05/2016/TT-BXD of Ministry of Construction dated March 10, 2016 guiding the determination of labor unit prices in construction investment cost management.

## Implementation costs

Table 7: Estimations for consulting service

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Item** | **Before taxation** | **Taxation** | **After taxation** |
| 1 | Topographic survey | 3.886.841.525 | 388.684.152 | 4.275.525.677 |
| 2 | Geological survey | 1.304.324.173 | 130.432.417 | 1.434.756.591 |
| 3 | Preparing construction drawing design | 4.552.700.000 | 455.270.000 | 5.007.970.000 |
|  | Total | 9.743.866.000 | 974.386.600 | 10.718.252.000 |

# COORDINATION AND MONITORING

* The Consultant must report to the Investor on the progress of the monthly implementation, prepare the documents and attend meetings/workshops on the relevant issues as required by the Investor.
* The Consultant will coordinate with the subproject implementation advisors and other stakeholders such as CPO and ADB/ AWP. Specifically, the discussions/inspections on milestones of subproject are required (as stated in the WEIDAP guidelines). The Consultant should closely coordinate and provide necessary data, information and reports for subproject implementation advisors and other stakeholders during the implementation process. The Consultant must participate in meetings and discussions with relevant agencies at the central and local levels.
* The Consultant should work closely with community representatives (traditional and non-traditional way) to ensure the information collection during the FS phase, and accurately assess the impacts of the subproject as well as related issues on the environmental and social protection policies.

# ORGANIZATION OF IMPLEMENTATION

* During the implementation of the task, the Consultant will report directly to PPMU. PPMU will be responsible for providing the Consultant with the contact information of other agencies as required.
* The Consultant must organize the implementation of the subproject. All relevant estimated costs must be anticipated in the bidding document and there will be no change in the total cost when signing the contract.
* All costs related to fieldwork and data needed to meet the technical requirements of this consulting work must be fully considered in the proposal. Terrain and meteorological data and other information must be expected during the bidding process to ensure that the work is completed within the estimated total cost. For this purpose, the Consultant must estimate the corresponding workload and costs because there will be no change in the total cost of the subproject after signing the contract for any reason.
* The Consultant will pay for all travel and accommodation related expenses (including field trips) for the entire consulting team during the contract period. The Consultant will also pay for all support staff (administrative, translators, office clerks, accountants) and field staff to perform the work for all data collection activities.
* Technical reports and consulting products will be provided as described in the distribution section. The Investor will only accept the sub-project when subproject implementation advisors agree with the consultingproducts and ADB issues the Non Objection Letter (NOL).

# SUPPORTS FROM THE INVESTOR

## Responsibilities of the Consultant

* Implement the consultancy service in accordance with the agreed content and workload, and regulations on the application of Vietnamese and ADB standards and regulations;
* Submit the report to the Investor within the time limit required by ToR;
* Ensure the mobilization and arrangement of personnel, offices and transport facilities;
* Ensure that all consulting works implemented by the Consultant are in accordance with Vietnamese law.
* Implement and be responsible for the quality of the consulting products;
* Participate in meetings related to consulting products when the Investor requests it during the implementation process, ensuring compliance with the regulations of MARD, PMU, PPC as well as the Sponsor; based on the Decision on approval of feasibility study report of the project and the subproject to recommends the Investor to supplement the missing contents according to the Decision;
* Commitment that the Consultant will appoint a competent representative to resolve any problems at any time at the request of the Investor.
* Comply with the direction and guidance of the investor, except for guidances or requirements that are contrary to the law or are not feasible.
* The Consultant shall not disclose any confidential or proprietary information relating to the consulting work, the contract or the work activities of the Investor without prior approval of the Investor in written document.
* The Consultant is responsible for searching and applying appropriate standards and regulations for the subproject. In the absence of such standards, the relevant international standards must be consulted and agreed by the Investor. Some key standards are expected to apply.

## Responsibilities of the Investor

* The Investor provides the Consultant with documents of the feasibility study and other relevant legal documents;
* Creates the best possible conditions for the Consultant to perform consulting work;
* Supports and creates conditions for the Consultant to have access to the works location;
* Provides necessary documents according to the Consultant's proposal for the Consultant to perform the consulting work. The Investor is responsible for the accuracy and completeness of the documents provided;
* Reviews the requirements and proposals of the Consultant regarding the implementation of consulting and approval work within a reasonable period of time so as not to delay the implementation of the consultancy;
* Pays for the Consultant as the contract price in accordance with the regulations;
* Answers in writing the proposals or requests of the Consultant;
* Appoints any qualified and professional individuals suitable to each job to work with the Consultant and specified in the specific decisions of the Investor.

For Clarification of the Terms of Reference only, please contact the Khanh Hoa provincial Project Management

Address: xxxxxxx

City: xxxxxx

Province: xxxxxx

Country: Viet Nam

Telephone: 84 xxxxxx

Fax: 84 xxxxxxx

Email : xxxxxx

(APPENDIXES:

# LEGAL BASIS

* Law of Construction No.50/2014/QH13 dated on 18/06/2014 by the National Assembly session 13;
* Law of Bids No.43/2013/QH13 dated on 26/11/2013 by the National Assembly session 13;
* Law of Investment No.49/2014/QH13 dated 18/6/2014 by the National Assembly session 13;
* Decree No.63/2014/NĐ-CP dated on 15/10/2009 by the Government regulating in details the implementing the Law of Bids and bidder selection under the Law of Construction;
* Decree No.16/2016/NĐ-CP by the Government regulating the capital management and usage from the Official Development Assistant (ODA) source and other preferential loan from foreign Sponsors.
* Decision No.48/QĐ-TTg dated on 03/04/2008 regulating the Guidance on feasibility study report using ODA source from 5 banks (ADB, AFD, JBIC, KfW, WB).
* Document No.1101/BKHĐT-THdated on 02/ 03/2015 by the Ministry of Planning and Investment regulating on the approval of the undertakings and decision of investment on public project and program.
* Circular No.02/2015/TT-BLĐTBXH dated on 12/01/2015 by Ministry of Labor, Invalids and Social Affairs regulating the salary levels for local consultants as the basis to estimate the bid of supplying consulting services using State capital in contract form.
* Decision No.1476/QD-BTCdated on 28/6/2016 on the disapproval of some articles at Circular No. 219/2009/TT-BTC and Circular No192/2011/TT-BTC by the Ministry of Finance.
* Circular No.40/2017/TT-BTC dated on 28/4/2017by the Ministry of Finance regulating the regime of business allowance fee and seminar/meeting fees;
* Document No.1447/VPCP- HTQT dated on 02/3/2015 by the Government Office on upgrading the efficiency cooperation with Sponsors of ODA and preferential loan.
* Cent Memorandum of the Visiting Members to ADB8 Project by Asia Development Bank on 30/3/2016.
* Decisions of the Ministry of Agriculture and Rural Development: No.3239/QĐ- BNN-TCCB dated on 22/10/2008 regulating functions, power, duties and organizational structure of the Central Management Committee for the irrigation projects; No.110/QĐ- BNN-TCCB dated on 13/01/2009 issuing the Charter of Operation and Structure for the Central Management Committee;
* Decision No.727/QĐ-TTg dated on 28/4/2016 by the Prime Minister on the approval of lists of ADB8 Projects with loans at Asia Development Bank (ADB).

# Standards applied to the survey and design work

| **No.** | **NUMBER** | **STANDARDS** |
| --- | --- | --- |
| **I** | **Standards used for survey work** | |
| 1 | QCVN 04 - 05: 2010/BNNPTNT | National technical regulation on irrigation works - the main regulations on design |
| 2 | QCVN 04 - 02: 2010/BNNPTNT | National technical regulations on composition, content of technical design documents and design of construction works of irrigation works. |
| 3 | TCVN 8478:2010 | Irrigation works - Requirements on composition and quantity of topographic survey during project and design phases |
| 4 | TCVN 8224:2009 | Irrigation works - The main regulations on net control of terrain |
| 5 | TCVN 8225:2009 | Irrigation works - The main regulations on net control of terrain elevation |
| 6 | TCVN 8226:2009 | Irrigation works - The main regulations on surveying cross- sections and topographic maps from 1/200 to 1/5000 |
| 7 | TCVN 8477 : 2010 | Irrigation works -Requirements on composition and quantity of geological survey in project planning and design phases |
| 8 | TCVN 9155-2012 | Irrigation works - Technical requirements for machine drilling in geological survey work |
| 9 | TCVN 8352-2012 | Construction land - Static test method |
| 10 | TCVN 8720-2012 | Land for construction of irrigation works - Methods of taking, packing, transporting and preserving samples |
| 11 | TCVN 8868- 2011 | Testing to determine non-cohesive shear resistance - non- draining and consolidation - drainage of soil adhesive on three-axis compression equipment |
| 12 | TCVN 9140-2012 | Irrigation works - Required to preserve drilling samples in engineering geological survey work |
| 13 | TCVN 9351-2012 | Construction land - Method of field Testing - Standard penetration test (SPT) |
| 14 | TCVN 4195:2012 | Construction land - Methods for determining specific gravity in the laboratory |
| 15 | TCVN 4196:2012 | Methods of determining humidity and moisture absorption in the laboratory |
| 16 | TCVN 4197:2012 | Methods of determining the flow limit and plastic limit in the laboratory |